

changed while the switching state of the other one of two switching elements each of which is the lower arm is kept, as described above.

[0166] Specifically, as illustrated in FIG. 17, the switching state of the switching element S4 is changed while the switching state of the switching element S3 is kept in the ON state even in the fifth example of the modified operation, as with the first example of the modified operation (see the switching states in the “L1 CHARGE #1” and the “L1 DISCHARGE #1”). Therefore, the switching loss of the switching element S3 is reduced while the electrical power converter 33a functions as the boost chopper circuit for the first electrical source 31.

[0167] On the other hand, as illustrated in FIG. 17, the switching state of the switching element S3 may be changed while the switching state of the switching element S4 may be kept in the ON state (see the switching states in the “L1 CHARGE #1” and the “L1 DISCHARGE #1”), when an electrical voltage V1 between both terminals of the lower arms for the first electrical source 31 (namely, an electrical voltage V1 between the ground line PL and the node N2) is equal to or smaller than an electrical voltage V2 between both terminals of the lower arms for the second electrical source 32 (namely, an electrical voltage V2 between the node N1 and the node N3). The electrical power which is outputted from the first electrical source 31 is stored in the reactor L1 (namely, the reactor L1 is charged), when the switching element S3 is in the ON state. The electrical power which is stored in the reactor L1 is supplied (namely, the reactor L1 discharges), when the switching element S3 is in the OFF state. Therefore, the switching loss of the switching element S4 is reduced while the electrical power converter 33a functions as the boost chopper circuit for the first electrical source 31.

[0168] On the other hand, it is preferable that the operation in which the switching state of the switching element S3 is changed while the switching state of the switching element S4 is kept in the ON state not be performed, when the electrical voltage V1 is larger than the electrical voltage V2 (see an operating condition in the “L1 CHARGE #2” and the “L1 DISCHARGE #2”). In other words, it is preferable that a situation where the switching elements S1 to S3 are in the OFF state and the switching element S4 is in the ON state not arise, when the electrical voltage V1 is larger than the electrical voltage V2. One reason is to prevent a charge between sources by which the electrical current flows from the first electrical source 31 to the second electrical source 32 (namely, the second electrical source 32 is charged by the first electrical source 31), wherein the charge between sources arises when the switching state of the switching element S3 is changed while the switching state of the switching element S4 is kept in the ON state under the situation where the electrical voltage V1 is larger than the electrical voltage V2. However, when the charge between sources is allowed, the switching state of the switching element S3 may be changed while the switching state of the switching element S4 may be kept in the ON state even under the situation where the electrical voltage V1 is larger than the electrical voltage V2 (see the operating condition in the “L1 CHARGE #2” and the “L1 DISCHARGE #2”).

[0169] In addition, in the fifth example of the modified operation, as illustrated in FIG. 17, the switching state of each of the switching elements S1 and S2 is kept in the OFF state.

Therefore, the switching loss of each of the switching elements S1 and S2 is reduced.

[0170] (4-2-6) Sixth Example of Modified Operation—The First Electrical Source 31 is Used, the Second Relay R2 is in the ON State and the Vehicle 1 is in the Regeneration State Next, with reference to FIG. 18, a sixth example of the modified operation, in which the electrical power converter 33a operates in the first single operation mode under a situation where the second relay R2 is in the ON state (moreover, the first relay R1 is in the ON state) and the vehicle 1 is in the regeneration state. FIG. 18 is a table which illustrates the switching states of the switching elements S1 to S4 in the sixth example of the modified operation in which the electrical power converter 33a operates in the first single operation mode under the situation where the second relay R2 is in the ON state (moreover, the first relay R1 is in the ON state) and the vehicle 1 is in the regeneration state.

[0171] Also in the sixth example of the modified operation, the switching state of one of two switching elements each of which is the upper arm for the first electrical source 31 is changed while the switching state of the other one of two switching elements each of which is the upper arm is kept, as described above.

[0172] Specifically, as illustrated in FIG. 18, the switching state of the switching element S2 is changed while the switching state of the switching element S1 is kept in the ON state (see the switching states in the “L1 CHARGE #1” and the “L1 DISCHARGE #1”). The electrical power which is generated by the regeneration is stored in the reactor L1 (namely, the reactor L1 is charged), when the switching element S2 is in the ON state. The electrical power which is stored in the reactor L1 is supplied (namely, the reactor L1 discharges), when the switching element S2 is in the OFF state. Therefore, the switching loss of the switching element S1 is reduced while the electrical power converter 33a functions as the step-down chopper circuit for the first electrical source 31.

[0173] However, the operation in which the switching state of the switching element S2 is changed while the switching state of the switching element S1 is kept in the ON state is preferably performed when the electrical voltage V1 is equal to or larger than the electrical voltage V2 (see an operating condition in the “L1 CHARGE #1” and the “L1 DISCHARGE #1”). In other words, it is preferable that the operation in which the switching state of the switching element S2 is changed while the switching state of the switching element S1 is kept in the ON state not performed when the electrical voltage V1 is smaller than the electrical voltage V2. In other words, it is preferable that a situation where the switching elements S1 and S2 are in the ON state and the switching elements S3 and S4 is in the OFF state not arise, when the electrical voltage V1 is smaller than the electrical voltage V2. One reason is to prevent the charge between sources by which the electrical current flows from the second electrical source 32 to the first electrical source 31 (namely, the first electrical source 31 is charged by the second electrical source 32), wherein the charge between sources arises when the switching state of the switching element S2 is changed while the switching state of the switching element S1 is kept in the ON state under the situation where the electrical voltage V1 is smaller than the electrical voltage V2. However, when the charge between sources is allowed, the switching state of the switching element S2 may be changed while the switching state of the